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Computer problems overcome during STS-100

By Julie Burt

On April 24 – the eve of what was to be a historical robotic-arm handshake in space – an alarm sounded in the Destiny lab of the International Space Station and in the Mission Control Center. The primary command and control computer's hard drive experienced a failure.

Expedition Two Flight Engineer Jim Voss, who said goodnight from the station six minutes earlier, returned from his sleep area to talk with the CAPCOM, or spacecraft communicator, in Mission Control.

The CAPCOM told Voss that the primary command and control computer could not link up with its hard drive. After repeatedly trying to gain access, they attempted to reset the computer. It failed, which set off the alarm.

Voss returned to bed when the backup computer, equipped with identical software, automatically took over. While they slept, the STS-100 and Expedition Two crews had no idea the days ahead would bring continuing computer problems and failures.

"These were the most serious events we have had since the beginning of the space station program," said station Lead Flight Director John Curry.

On April 25, eight hours after it was brought on as primary, the second computer began to show similar trouble and could not access its hard drive. Troubleshooters in Mission Control wanted to switch over to a clean computer to resume the day's activities. One more computer waited on standby to take over if needed.

Upon recommendations from the Onboard, Data, Interfaces and Networks (ODIN) team and the Mission Evaluation Room (MER), Curry authorized the switchover to the third computer.

Against probability, the third computer did not work. After attempting to reset the computer, Mission Control lost all status data, or telemetry, from the station. The crew could not connect any of the United States system computers, leaving both Mission Control and the crew "blind" as to the status of the their systems.

In Building 30 at Johnson Space Center, Mission Evaluation Room personnel led the effort to understand the failures and recommend corrective action. The Mission Evaluation Room is in charge of the sustaining engineering and responsible for solving all on-orbit problems. "The MER has a lot of capability to put a lot of brainpower on problems. This problem was a real test of that," MER Manager Scott Gahring said.

They called Honeywell–the primary contractor for the command and control computers–immediately when the problem surfaced. Key personnel flew to Houston while their Glendale, Ariz., team stayed involved in real-time evaluations.

continued on page 6

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The ODIN team with ISS Lead Flight Director John Curry gather to hang the STS-100 plaque.

Success!

Onboard crews and robotics flight controllers work to complete historical handshake

In the hours before the computers failed, the crew had completed Flight Day Four activities. This included the installation of the station's robotic arm, Canadarm2, to the lab cradle assembly on the Destiny lab. It was powered up and ready to go for the next day's activities–a loaded checkout of Canadarm2 and the transfer of the space lab pallet–the device on which it was launched –to the Shuttle's robotic arm.

The station arm hung over the Destiny lab holding the pallet while the crew slept and while the failures were occurring.

Unfortunately, the failures made it impossible for the crew to perform robotics operations as they were trained. Software needed to be loaded on the SSRMS from the failed computers. Since the hard drives could not be accessed, the software stored in them was out of reach as well.

The STS-100 lead robotics flight controller, Aaron Goldenthal, had to act fast. He sent updated procedures to the robotics trainers for verification. Then, he told the crew that they would now have to work in what is known as "single joint mode." Instead of being able to program the arm to move to a certain place and then push a "go" button, they would now have to activate each individual movement separately.

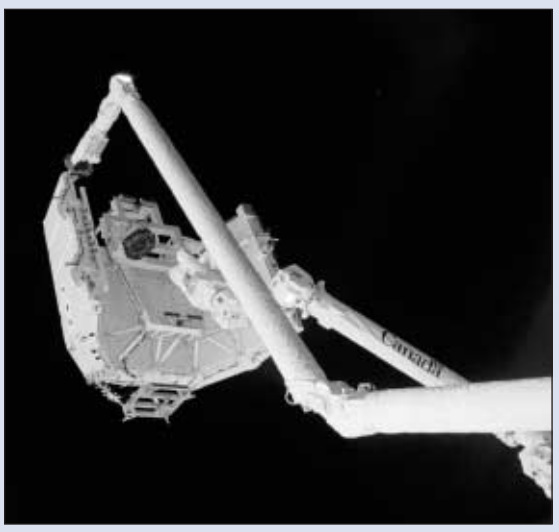
As if that was not enough, the Robotic Work Station could not pick up the arm's activity. This made for a long process of the crew executing a command and the ground confirming the command was accepted.

The robotics flight controller would send up a procedure for the crewmember to follow. The crewmember would manually turn a switch to choose a joint on the Station's arm. The arm would move in a selected direction. Then the crewmember would put on the brakes. Finally, the robotics flight controller would have to confirm that the movement occurred.

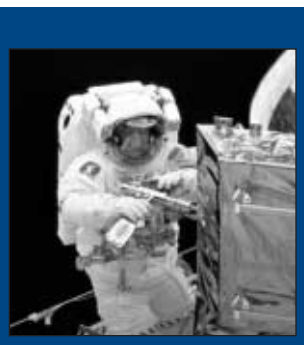
"It was like watching grass grow," said lead station robotics trainer Lane Honeycutt. Under normal circumstances, the robotics operations were supposed to take four hours and 30 minutes. The crew only exceeded this by an hour and a half, doing the operations virtually manually with almost no computers working.

"The coordination between the crew and the robotics Flight Control teams was a picture of perfection," Honeycutt said.

The space lab pallet was handed off and the Station's new arm was in a good configuration for the next assembly mission, 7A. ■



Though operating in 'single joint mode,' the Canadarm2 handed over its space lab pallet to the shuttle's robotic arm.



EVA achievements recognized. Page 3

Chili cookoff winners announced. Page 4

Safety and Health Fair a success. Page 5